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TABLES OF DRIFT VELOCITIES OF SLOW ELECTRONS IN HELIUM, NEON, ARGON, KRYPTON, XENON, HYDROGEN, DEUTERIUM, NITROGEN, CARBON MONOXIDE, CARBON DIOXIDE, WATER VAPOR, NITROUS OXIDE, AND AMMONIA*

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Tables of Drift Velocities of Slow Electrons in Helium, Neon, Argon, Krypton, Xenon, Hydrogen, Deuterium, Nitrogen, Carbon Monoxide, Carbon Dioxide, Water Vapor, Nitrous Oxide, and Ammonia*

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ABSTRACT

This report presents in tabulated form the drift velocities of electrons in various gases. The drift velocities were measured in helium, neon, argon, krypton, xenon, hydrogen, deuterium, nitrogen, carbon monoxide, carbon dioxide, water vapor, nitrous oxide, and ammonia for E/p values from 10^{-4} to 30 volts/cm-mm Hg at several gas temperatures between 77°K and 443°K. In all gases except neon measurements were extended to low enough E/p such that the electrons were in thermal equilibrium with the gas.

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I. EXPLANATION OF TABLES

This paper reports in tabulated form the measurements of drift velocities of electrons in helium, neon, argon, krypton, xenon, hydrogen, deuterium, nitrogen, carbon monoxide, carbon dioxide, water vapor, nitrous oxide, and ammonia. Discussions of the experimental technique, graphs of the data, and a partial analysis of the data are contained in previous papers.[1,2]

The following notation is used:[1]

$W_e(T)$ = drift velocity in centimeters per sec (cm/sec) at temperature T

Drift Distances = distance from the cathode to grid number 1 and from the cathode to grid number 2.

The values of E/p_{300} are expressed in units of volt/cm-mm Hg for an equivalent density at 300°K, i.e., $E/p_{300} = (E/N)\ 3.22 \times 10^{16}$ for all data given in this paper. Here N is the gas density. The normalized pressures, p_{300}, are the values measured using the manometer system and multiplied by 300/T. Here T is the temperature of the gas in the mobility tube.

The bias and rejection methods of obtaining the data are discussed under the "Conventional Grid Operation" and "Zero-Bias

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1. J. L. Pack and A. V. Phelps, Phys. Rev. 121, 798 (1961).
2. J. L. Pack, R. E. Voshall, and A. V. Phelps, Phys. Res. 127, 2084 (1962).

Operation" sections of reference 1. Data were often taken at different pressures at constant E/p_{300} and a constant temperature thus giving a check on the measurements. The drift velocities are independent of pressure at a fixed E/p_{300} and temperature within the scatter of the data.

In helium, data were taken at two sets of drift distances and were consistent with each other. In all other gases data were taken at one set of drift distances. The data obtained by the bias method were identical to those obtained by the rejection method, except where excessive bias voltages were required to cut off the grids. In these cases and in the later gases studied the rejection method was used. Values are reported only if drift velocities calculated for the two drift distances agree within 10 percent. Exception to this are argon for $E/p_{300} < 0.0015$ where the difference was as large as 35 percent. In these cases the drift velocity was taken as the difference in the distances divided by the difference in transit times. Note that analysis of the neon data for $E/p_{300} < 10^{-2}$ by L. S. Frost and A. V. Phelps (private communication) shows that the data at 77°K and 300°K lead to apparent momentum transfer cross sections differing by as much as 30 percent and suggest errors in one or both sets of drift velocity data of as much as 10 percent.

The estimated uncertainties in voltage and pressure are discussed in reference 1. The distances between the grid wire mounts were measured to 1 percent. Warpage of the individual grid wires was less than $\pm$ 5 percent of the distance to the nearest grid or cathode.

II. TABLES

Table I - He

Drift velocity of electrons in helium
Drift distances = 1" and 2"

E/p_{300} (volts/ cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm-Hg)	W_e (195°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)
1.0					9.65×10^5	9.86
0.5					6.44×10^5	9.86
0.4					5.6×10^5	97.3
0.2	3.8×10^5*	144			4.0×10^5	10.0
"					5.7×10^5	10.0
0.15					3.22×10^5	407.9
0.10	2.82×10^5*	144			2.62×10^5	98
"	2.83×10^5	555			2.60×10^5*	98
"					2.69×10^5	693
0.05	2.09×10^5*	144	1.95×10^5	965	1.87×10^5	98
"					1.85×10^5*	98
0.04					1.67×10^5	405.7
0.0333					1.51×10^5	693
0.025			1.345×10^5	965		
"			1.39×10^5	970		
0.02	1.27×10^5*	144			1.08×10^5	405.7
0.01	8.75×10^4*	144	7.5×10^4	970	6.43×10^4*	98
"	8.60×10^4	555			6.70×10^4	693
"	8.80×10^4*	956				
0.007					5.0×10^4	405.7
0.006	6.5×10^4	1233				
0.005	5.81×10^4*	144	4.38×10^4	970	3.54×10^4*	98
"	5.60×10^4*	956			3.68×10^4	693
0.003	3.98×10^4	555			2.36×10^4	405.9
"					2.32×10^4	689
0.002	2.80×10^4*	956	1.36×10^4	970	1.575×10^4	689
0.0015	2.23×10^4	1238			1.18×10^4	405.7
0.0014					1.10×10^4	689
0.001	1.55×10^4	952	1.015×10^4	970	7.95×10^3	689
"	1.51×10^4*	956				
0.0009	1.37×10^4	555				
0.0003	1.24×10^4	1238				
0.00075					5.77×10^3	405.7
0.0007					5.70×10^3	689
0.0005	8×10^3	952	5.08×10^3	970	4.31×10^3*	689
"					4.50×10^3	689
"					4.10×10^3	689
0.0004	6.53×10^3	1238			3.44×10^3	689
0.000257					2.12×10^3	689
0.00025			2.65×10^3	965		

*Denotes bias method - all others by rejection method.

Table I - He
(cont.)

E/P_{300} (volts/ cm-mm Hg)	W_e (77°K) (cm/sec)	P_{300} (mm-Hg)	W_e (195°K) (cm/sec)	P_{300} (mm-Hg)	W_e (300°K) (cm/sec)	P_{300} (mm-Hg)
0.0002	3.22×10^3	1238				
0.0001	1.69×10^3	1238				
Drift distances - 2" and 4"						
1.0					9.55×10^5	8.40
0.3					5.40×10^5	8.40
0.222					4.20×10^5	94.1
0.100					2.80×10^5	94.1
0.03					1.425×10^5	94.1
0.01					6.88×10^4 to 6.60×10^4	94.1
0.003					2.36×10^4	94.1
0.001					7.95×10^3	544
0.0005					4.20 to 4.42×10^3	544

Table II - Ne

Drift velocity of electrons in Neon
Drift distances = 1" and 2"

E/p_{300} (volts/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)
1.0			1.64×10^6*	18.
0.5			7.9×10^5*	48.35
0.20			4.94×10^5*	"
"			4.50×10^5*	291
0.129			3.90×10^5	466
0.108	3.63×10^5	545		
0.10			3.60×10^5*	48.35
"			3.30×10^5*	291
0.05	2.55×10^5	905	2.80×10^5*	48.35
"			2.54×10^5*	291
0.03			2.10×10^5	662
0.02	1.81×10^5	905	1.70×10^5	466
"			1.72×10^5*	291
0.01	1.33×10^5	545	1.27×10^5*	291
"			1.30×10^5	662
0.008	1.25×10^5	905		
0.006			1.00×10^5*	466
"			1.03×10^5	"
0.005			1.0×10^5	291
"			1.0×10^5	662
0.004	9.80×10^4	905		
0.003	8.83×10^4	545		
0.0024			7.1×10^4*	446
0.002			6.53×10^4	662
"			6.87×10^4	291
0.0015	6.53×10^4	905		
0.0013	6.05×10^4	905		
0.0012			5.4×10^4	466
0.001			5.24×10^4	291
"			4.96×10^4	654
0.00069			3.55×10^4	654
0.00065	4.84×10^4	905		
0.0006			3.74×10^4	466
0.0005			3.40×10^4	291
"			3.0×10^4	654
0.00043	3.63×10^4	905		
0.000425			3.17×10^4	466
0.00036			2.54×10^4	654

* Denotes Bias method used - all others by rejection method.

Table III

Drift velocity of electrons in Argon
Drift distances = 1" and 2"

E/p_{300} (volt/cm-mm Hg)	W_e(77°K) (cm/sec)	P_{300} (mm Hg)	W_e(300°K) (cm/sec)	P_{300} (mm Hg)
0.485			3.22×10^5	151.5
0.395			3.07×10^5	"
0.300			3.00×10^5	"
0.250			2.90×10^5	"
0.20			2.60×10^5*	297
0.12			2.36×10^5	151.5
0.10			2.27×10^5*	297
"			2.24×10^5*	462
0.0804			2.13×10^5	735
0.080	2.16×10^5*	740		
0.076	2.09×10^5*	780		
0.060			2.10×10^5	151.5
0.050			1.94×10^5*	297
"			1.88×10^5*	462
0.030			1.78×10^5	151.5
0.020	1.52×10^5*	780	1.54×10^5*	297
"			1.50×10^5	462
0.018	1.50×10^5	722		
0.0154			1.39×10^5*	735
0.01			1.30×10^5	297
"			1.34×10^5*	297
"			1.27×10^5	462
0.0076			1.16×10^5*	735
0.0062	1.13×10^5	710		
0.0050	1.10×10^5*	780	1.22×10^5	297
"			1.10×10^5	462
"			1.08×10^5*	"
0.00353			1.01×10^5*	735
0.0030	9.8×10^4	735		
0.002	9.25×10^4*	780	9.40×10^4	462
"			9.60×10^4*	462
0.00154			8.45×10^4	735
0.0015	6.12×10^4	735		
"	6.90×10^4*	780		
0.0010	2.67×10^4*	780	5.90×10^4	462
"	2.20×10^4*	735	6.20×10^4*	462
0.0008	1.59×10^4*	746		
0.00078	1.68×10^4*	746		
0.00077			4.60×10^4*	735
0.0005	9.4×10^3*	735	2.16 to	
"	9.8×10^3*	746	2.42×10^4*	735
0.00036			1.61×10^4*	735
0.0003	5.25×10^3*	746		
0.00026	5.0×10^3*	735		
0.00025	4.45×10^3*	735		
0.00020	3.54×10^3*	746	8.3×10^3*	735
			8.9×10^3*	735

* = bias method, all others by rejection method.

Table IV - Kr

Drift velocity of electrons in Krypton
Drift distances = 2" and 4"

E/p_{300} (volts/cm-mm Hg)	W_e (195°K) (cm/sec) all at p_{300}=885 mm Hg	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)	W_e (368°K) (cm/sec)	p_{300} (mm-Hg)
1.00		3.14×10^5	15.36		
0.80		2.49×10^5	31.69		
0.596		2.42×10^5	31.69		
0.500		2.26×10^5	61.20		
0.300		2.02×10^5	61.20		
0.392		1.89×10^5	155.2		
0.200		1.77 "	155.2		
0.100		1.55 "	405.3		
0.05		1.35	405.3		
0.03	1.275×10^5				
0.025		1.25 "	405.3		
0.015	1.17 "	1.19 "	407		
0.010	1.00×10^5	9.95×10^4	405.3		
"		1.035×10^5	757.3		
0.009		1.00×10^5	407		
0.008	7.95×10^4	9.03×10^4	407		
"		8.45×10^4	757.3		
0.007		6.32×10^4	408		
0.006	4.02×10^4	5.14×10^4	757.3		
0.00558		4.25×10^4	405.3		
0.005		3.29×10^4	408		
0.004	1.612×10^4	2.12×10^4	408		
"		2.24×10^4	757.3		
0.003	1.09×10^4	1.332×10^4	408		
0.0025		1.07×10^4	757.3		
0.002	7.14×10^3	8.75×10^3	405.3	9.27×10^3	687
0.0015	5.35×10^3	6.12×10^3	757.3		
0.001	3.62×10^3	4.01×10^3	405.3	4.4×10^3	687
0.0007				3.12×10^3	687
0.0006		2.35×10^3	757.3		
0.0005	1.745×10^3	2.12×10^3	407	2.15×10^3	687
0.0004		1.576×10^3	757.3		
0.0003		1.30×10^3	757.3		
0.00026		1.096×10^3	757.3		

Table V - Xe

Drift velocity of electrons in Xenon
Drift distances - 2" and 4"

E/p_{300} (volts/cm-mm Hg)	W_e (195°K) (cm/sec)	P_{300} (mm-Hg)	W_e (300°K) (cm/sec)	P_{300} (mm-Hg)
1.0			1.78×10^5	20.36
0.70			1.57 "	39.30
0.594			1.53 "	"
0.50			1.56 "	"
"			1.42 "	79.3
0.40			1.44 "	39.3
0.30			1.29 "	79.3
"			1.27 "	149.6
0.20			1.215 "	79.3
"			1.22 "	149.6
0.15			1.09 "	299.1
0.125			1.11 "	79.3
0.10			1.04 "	149.6
0.08			9.9×10^4	299.1
0.07			9.82 "	149.6
0.06			9.64 "	299.1
0.05			9.75 "	149.6
0.04			8.87 "	299.1
0.035			8.50 "	721.9
0.03			8.08 "	299.1
0.025	7.31×10^4	831	7.48 "	299.1
0.0225			7.16 "	721.9
0.020	5.77×10^4	832	6.51 "	299.1
0.018			5.77 "	721.9
0.016			4.84×10^4	730
0.015	3.015×10^4	832		
"	2.82×10^4	562		
0.014			3.72×10^4	299.1
"			3.79 "	730
0.0125	1.855×10^4	562		
"	1.815 "	833		
0.012			2.34×10^4	299.1
"			2.54×10^4	482
"			$2.65 \times$ "	730
0.010	1.19×10^4	571	1.42×10^4	149.6
"	1.13×10^4	833	1.67×10^4	482.7
"			1.775×10^4	730
0.009			1.284×10^4	299.1
0.008	8.06×10^3	833		
0.0075			9.81×10^3	730
0.0070			8.51×10^3	149.6
0.006	5.98×10^3	835	7.34×10^3	300.9
0.005			6.14×10^3	149.6
0.0045			5.35×10^3	730
0.004	4.01×10^3	833	4.86×10^3	300.9

Table V - Xe
(contd)

E/p_{300} (volts/cm-mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)
0.004			4.70×10^3	149.6
0.003			3.63×10^3	149.6
0.0025			2.88×10^3	730
0.0020	2.02×10^3	571	2.51×10^3	149.6
"	$1.95 \times$ "	839	2.41×10^3	300.9
0.0015			1.84×10^3	149.6
0.0010	9.66×10^2	839	1.23×10^3	300.9
"			1.22×10^3	730
0.0005			5.78×10^2	300.9

Table VI - H_2

Drift velocity of electrons in Hydrogen
Drift distances = 1" and 2"

E/p_{300} (volts/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm-Hg)	W_e (195°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)	W_e (373°K) (cm/sec)	p_{300} (mm-Hg)
10.0					4.23×10^6	4.30		
5.0					2.68×10^6	4.30		
3.0					2.0×10^6	18.44		
2.0	1.53×10^6	26.4	1.64×10^6	21.1	1.55×10^6	18.44		
"					1.51×10^6	4.30		
1.0	1.07×10^6	26.4	1.06×10^6	21.1	1.02×10^6	4.30	1.05×10^6	46.4
"			1.13×10^6	36.2	1.03×10^6	18.44		
"					1.04×10^6	53.5		
0.79			9.55×10^5	75				
0.50	8.10×10^5	26.4	8.05×10^5	21.1	7.50×10^5	18.44		
"	8.40×10^5	71.6	8.00×10^5	36.2				
"			7.94×10^5	75				
0.30			6.34×10^5	61.8				
0.25			6.0×10^5	230				
0.20	5.76×10^5	26.4	5.25×10^5	21.1	5.08×10^5	4.32	4.61×10^5	47
"	5.50×10^5	71.6	5.08×10^5	73.3	4.80×10^5	18.44	4.60×10^5	182
"	5.71×10^5	279	5.40×10^5	75	5.00×10^5	53.5		
"					4.62×10^5	203.9		
0.18	5.35×10^5	415						
0.10	3.82×10^5	26.4	3.34×10^5	29.6	3.21×10^5	18.44	2.82×10^5	46.4
"	3.78×10^5	280	3.47×10^5	73.3	3.11×10^5	52.2	3.03×10^5	182
"	3.94×10^5	415	3.67×10^5	75	3.14×10^5	201.4	2.90×10^5	591
"			3.42×10^5	230	3.00×10^5	203.9		
"			3.48×10^5	618	3.22×10^5	297		
0.08					2.85×10^5	920		
0.05	2.35×10^5	26.4	2.16×10^5	59.6	1.90×10^5	18.44	1.78×10^5	47
"	2.32×10^5	71.6	2.23×10^5	73.3	1.86×10^5	52.2	1.74×10^5	182
"	2.35×10^5	280	2.17×10^5	230	1.85×10^5	202	1.72×10^5	591
"	2.51×10^5	415	2.23×10^5	761	1.88×10^5	647		
"	2.50×10^5	916						

Table VI - H_2

(Contd)

E/p_{300} (volts/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm-Hg)	W_e (195°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)	W_e (373°K) (cm/sec)	p_{300} (mm-Hg)
0.04					1.68×10^5	920		
0.03					1.27×10^5	297		
0.025			1.29×10^5	59.6	1.11×10^5	52.2	1.04×10^5	182
"			1.33×10^5	61.8	1.07×10^4	202		
0.02	1.20×10^5	71.6	1.12×10^5	73.3	8.25×10^4	204	7.7×10^4	182
"	1.25×10^5	280	1.08×10^5	230	8.75×10^4	647	8.1×10^4	591
"	1.27×10^5	415	1.10×10^5	761	9.1×10^4	927		
"	1.34×10^5	916						
0.01	7.72×10^4	280	6.0×10^4	59.6	4.55×10^4	52.2	4.04×10^4	47
"	7.80×10^4	415	6.20×10^4	73.3	4.50×10^4	202	4.10×10^4	182
"	8.10×10^4	916	5.92×10^4	230	4.92×10^4	297	3.95×10^4	591
"	7.84×10^5	1300	5.92×10^4	761	4.54×10^4	647		
0.008					3.95×10^4	920		
0.005	4.52×10^4	71.6			2.36×10^4	52.2	2.0×10^4	180
"	4.54×10^4	280	3.0×10^4	59.6	2.34×10^4	202	1.98×10^4	591
"	4.63×10^4	297	3.20×10^4	230	2.47×10^4	297		
"	4.72×10^4	916	3.10×10^4	761	2.33×10^4	647		
0.004					2.00×10^4	920		
0.00318					1.57×10^4	297		
0.003	3.06×10^4	415						
"	2.99×10^4	1290						
0.0025					1.14×10^4	201.4		
"					1.24×10^4	920		
0.002	2.08×10^4	280	1.27×10^4	230	9.8×10^3	203	8.62×10^3	181
"	2.12×10^4	916	1.28×10^4	761	1.00×10^4	297	8.50×10^3	591
"	2.10×10^4	1290			9.10×10^3	647		
"					1.00×10^4	928		
0.00124					6.06×10^3	920		
0.001	1.07×10^4	280	6.45×10^3	761	5.12×10^3	297	4.25×10^3	591
"	1.08×10^4	415			4.84×10^3	647		
"	1.08×10^4	916			5.23×10^3	920		
"	1.05×10^4	1290						

Table VI - H_2
(Contd)

E/p_{300} (volts/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm-Hg)	W_e (195°K) (cm/sec)	p_{300} (mm-Hg)	W_e (300°K) (cm/sec)	p_{300} (mm-Hg)	W_e (373°K) (cm/sec)	p_{300} (mm-Hg)
0.0008					3.94×10^3	928		
0.00075					3.82×10^3	657		
0.0005	5.02×10^3	279	3.18×10^3	761	2.57×10^3	657		
"	5.40×10^3	916			2.52×10^3	920		
"	5.14×10^3	1290						
0.0004					2.12×10^3	927		
0.000375					2.27×10^3	657		
0.0003			1.88×10^3	761				
0.00025	2.76×10^3	916						
	2.65×10^3	1290						

Table VII - D_2

Drift velocity of electrons in Deuterium
Drift distances - 2" and 4"

E/p_{300} (volt/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)
7.45			2.90×10^6	1.74
5.45			2.44×10^6	5.08
4.46			2.18×10^6	5.09
2.98			1.73×10^6	1.74
2.68			1.62×10^6	5.09
2.23			1.47×10^6	5.09
1.49			1.19×10^6	5.09
1.19			1.06×10^6	5.09
1.00			9.56×10^5	36.1
0.89			9.06×10^5	5.09
0.81	8.61×10^5	42.3		
0.70			7.82×10^5	35.5
0.605			7.33×10^5	5.09
0.60	7.42×10^5	65.8		
0.50			6.82×10^5	36.2
0.40	6.80×10^5	65.8	6.10×10^5	100.2
0.30	6.13×10^5	66.6	5.40×10^5	35.5
0.20	5.38×10^5	66.6	4.58×10^5	35.5
0.15	4.94×10^5	65.8	4.06×10^5	100.2
0.10	4.12×10^5	393	3.19×10^5	36.2
"			2.89×10^5	100.2
0.07	3.45×10^5	393	2.36×10^5	99.3
"			2.50×10^5	99.3
0.06			2.29×10^5	100.2
"			2.19×10^5	671.2
0.0518	3.10×10^5	569		
0.050	2.94×10^5	396	2.06×10^5	288.5
0.040			1.73×10^5	100.2
0.035			1.45×10^5	656.2
0.032	2.20×10^5	916		
0.03	2.17×10^5	567	1.32×10^4	288.5
0.02	1.57×10^5	399	9.18×10^4	658.2
0.0196			9.11×10^4	100.2
0.015	1.25×10^5	914	7.11×10^4	288.5
0.01	9.21×10^4	399	4.84×10^4	100.1
0.009			4.30×10^4	658.2
0.007	6.84×10^4	569	3.35×10^4	288
0.005	4.98×10^4	543	2.42×10^4	288
0.00461			2.24×10^4	660.5
0.0035	3.68×10^4	914		
0.003			1.43×10^4	288
0.0025	2.63×10^4	543		
0.002			9.50×10^3	286.6
0.0015	1.62×10^4	914	7.25×10^3	660.5
0.001	1.02×10^4	543	4.62×10^3	286.4
0.001			5.03×10^3	286.4
0.00075	8.13×10^3	914		

Table VIII - N_2

Drift velocity of electrons in Nitrogen
Drift distances = 1" and 2" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm Hg)	W_e (195) (cm/sec)(all at 990 mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)	W_e (373°K) (cm/sec)(all at p_{300} = 594 mm Hg)
10.0				4.3×10^6	1.79	
3.0				1.87×10^6	1.81	
"				1.91×10^6	19.3	
1.0				8.0×10^5	19.3	
0.3				4.24×10^5	19.3	
0.2				3.9×10^5	287.1	
0.1	3.31×10^5	600		3.09×10^5	19.3	
"				3.16×10^5	287.1	
0.0945						2.95×10^5
0.08	3.40×10^5	600				
0.06			3.1×10^5			
0.05				2.73×10^5	287.1	2.52×10^5
0.04	3.70×10^5	600	2.92×10^5			
0.03			2.83×10^5			
0.02	3.52×10^5	600	2.37×10^5	1.83×10^5	287.1	1.59×10^5
0.01	2.69×10^5	600	1.52×10^5	1.08×10^5	287.1	
0.00945						8.2×10^4
0.005	1.72×10^5	600	8.36×10^4	5.80×10^4	287.1	4.70×10^4
0.002	7.51×10^4	600	3.30×10^4	5.78×10^4	531	1.95×10^4
"			3.43×10^4	2.37×10^4	287.1	
"				2.31×10^4	531	
0.0015				1.73×10^4	746	
0.001	4.06×10^4	600	1.78×10^4	1.18×10^4	287.1	9.93×10^3
"	3.82×10^4	1200		1.17×10^4	741	
"				1.21×10^4	746	
"				1.22×10^4	535.1	
0.0008				9.2×10^3	746	
0.0005	1.98×10^4	600	8.85×10^3	6.35×10^3	531	5.0×10^3
"	1.94×10^4	1200		6.35×10^3	746	3.50×10^3
0.0004	1.49×10^4	1215		5.35×10^3	746	
0.00025	1.10×10^4	600	4.54×10^3	3.22 to		
"	1.00×10^3	1200		3.82×10^3	746	
0.0002	7.94×10^3	1215				
0.00015	5.30×10^3	1200				
0.0001	4.17×10^3	1215				

Table IX - CO

Drift velocity of electrons in Carbon Monoxide
Drift distances = 2" and 4" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (77°K) (cm/sec)	p_{300} (mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)
8.0					2.75×10^6	5.14
4.94					2.30×10^6	3.41
3.31					2.06×10^6	10.3
2.51					1.95×10^6	3.41
1.0					1.48×10^6	3.41
"					1.41×10^6	5.06
0.70					1.28×10^6	10.3
0.50			1.02×10^6	14.2	1.02×10^6	5.41
0.40	9.40×10^5	72.5				
0.35					8.80×10^5	10.3
0.30					8.29×10^5	31.2
0.25	7.70×10^5	72.5				
0.207			6.78×10^5	59.4		
0.20	7.65×10^5	72.5	6.91×10^5	225	6.48×10^5	31.2
0.195	7.37×10^5	135				
0.175	7.70×10^5	199				
0.150	7.76×10^5	199	6.45×10^5	225	5.55×10^5	41.0
0.125	7.81×10^5	135	6.36×10^5	225		
0.10	7.88×10^5	199	5.81×10^5	225	4.87×10^5	21.0
0.0955	7.55×10^5	166				
0.0785	6.94×10^5	511				
0.075			5.0×10^5	225	4.35×10^5	21
"					3.91×10^5	41.0
0.065	6.15×10^5	507				
0.050	5.05×10^5	139	3.67×10	225	3.40×10	21.0
0.04					2.40×10^5	16.5
0.03					1.95×10^5	21.0
0.025	2.46×10^5	135	1.95×10^5	225	1.59×10^5	20.6
0.020	2.11×10^5	507			1.30×10^5	41.0
0.015					1.17×10^4	41.0
0.0143					9.33×10^4	20.6
0.01	1.05×10^5	135	7.84×10^4	225		
"	1.02×10^5	507				
0.0075			6.12×10^4	227		
0.00503			4.06×10^4	227		
0.005	5.29×10^4	509				
0.003	3.18×10^4	509				
0.001	1.01×10^4	509				

Table X - CO_2

Drift velocity of electrons in Carbon Dioxide
Drift distances = 2" and 4" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)	W_e (413°K) (cm/sec)	p_{300} (mm Hg)
7.0			7.5×10^6	2.19		
5.0			4.94×10^6	2.19		
3.0			1.83×10^6	2.19		
2.0			1.18×10^6	2.19		
"			1.15×10^6	19.75		
1.0			5.65×10^5	19.75		
0.5			2.825×10^5	19.75		
0.3			1.67×10^5	19.75		
0.2			1.17×10^5	19.75	1.07×10^5	105
0.1			5.58×10^4	19.75		
"	5.54×10^4	328	5.46×10^4	291	5.427×10^4	253
"			5.58×10^4	19.75	5.48×10^4	105
0.05	2.82×10^4	328	2.82×10^4	19.75	2.74×10^4	165
0.02	1.10×10^4	328	1.13×10^4	19.75	1.08×10^4	165
"			1.13×10^4	291	1.085×10^4	253
0.01	5.55×10^3	328	5.65×10^3	291		
0.005	2.82×10^3	328	2.825×10^3	291		
0.002	1.13×10^3	328				

Table XI - H_2O

Drift velocity of electrons in Water Vapor
Drift distances = 2" and 4" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)	W_e (443°K) (cm/sec)	p_{300} (mm Hg)
27.5			9.6×10^6	1.10
20	6×10^6	1.36		
18.7			5.0×10^6	1.00
18.0			3.7×10^6	.96
16.0	1.92×10^6	1.75		
15.0	1.75×10^6	1.26		
14.0	1.35×10^6	1.75	1.835×10^6	.96
13.5	1.20×10^6	2.33		
11	9.4×10^5	1.26		
10.5	9.0×10^5	1.75		
10.0	8.4×10^5	1.75	1.0×10^6	.96
8.0	6.5×10^5	1.26		
6.0			5.90×10^5	3.43
5.0			4.68×10^5	.96
4.0	3.08×10^5	2.33		
1.95	1.36×10^5	20.78		
1.50			1.37×10^5	3.43
1.00	7.40×10^4	20.3	9.40×10^4	15.2
.60			5.65×10^4	3.43
.5	3.68×10^4	20.78		
.4	3.03×10^4	2.33		
.2	1.46×10^3	5.6		
.103	7.88×10^3	5.6		
.10			9.75×10^3	15.1
.02	1.49×10^3	24.60		

Table XII - N_2O

Drift velocity of electrons in Nitrous Oxide
Drift distances = 2" and 4" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)
1.50			3.69×10^6	29.5
1.33	3.63×10^6	22.11		
1.00			2.65×10^6	29.5
0.886			2.31×10^6	48.5
0.835			2.12×10^6	29.5
0.70			1.72×10^6	48.3
0.585	1.55×10^6	22.11		
0.585	1.42×11^6	50.5		
0.50			1.24×10^6	29.5
"			1.20×10^6	48.3
0.449			9.85×10^5	101.7
0.419			7.20×10^5	97.5
0.30			6.87×10^5	48.6
"			6.07×10^5	98.6
0.29	6.09×10^5	100		
0.231			5.03×10^5	97.3
0.20			4.38×10^5	29.5
"	4.24×10^5	50.5	4.27×10^5	48.1
"			3.91×10^5	101.8
0.10	2.07×10^5	50.5	2.10×10^5	48.1
"	2.06×10^5	100	1.99×10^5	97.8
"			2.00×10^5	102.2
0.07			1.48×10^5	48.2
0.0621			1.196×10^5	98.6
0.04			8.26×10^4	48.2

Table XIII - NH_3

Drift velocity of electrons in Ammonia
Drift distances = 2" and 4" by rejection method only

E/p_{300} (volt/cm-mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)	W_e (381°K) (cm/sec)	p_{300} (mm Hg)
15.0			7.7×10^6	.71		
12.7					6.0×10^6	2.64
12.0	5.35×10^6	2.28				
10.0	2.42×10^6	2.28	2.60×10^6	.71	3.53×10^6	2.64
"	2.65×10^6	2.30	3.08×10^6	2.20	3.50×10^6	3.10
9.40			2.54×10^6	2.20		
9.0	1.91×10^6	2.28	1.95×10^6	3.75		
8.50			1.64×10^6	4.29		
8.00	1.30×10^6	2.28	1.61×10^6	2.20	1.92×10^6	3.16
7.50			1.31×10^6	.71		
7.0	1.01×10^6	2.28				
6.65			1.10×10^6	4.29	1.31×10^6	3.10
"			1.10×10^6	3.75		
6.0					1.16×10^6	3.16
5.9	7.25×10^5	6.35				
5.6	6.6×10^5	2.03				
5.0			7.5×10^5	3.75		
"			7.0×10^5	4.29		
4.0	4.38×10^5	2.03	5.6×10^5	10.62	6.95×10^5	2.64
"					6.80×10^5	3.16
3.0			4.12×10^5	13.94		
2.50	2.66×10^5	4.62	3.38×10^5	4.29		
2.0	2.18×10^5	2.03	2.82×10^5	3.75	3.39×10^5	2.64
"	2.0×10^5	17.65	2.74×10^5	13.94	3.27×10^5	3.16
"					3.23×10^5	11.2
"					3.06×10^5	14.6
1.0	1.075×10^5	2.03	1.39×10^5	3.75	1.56×10^5	11.2
"	1.00×10^5	17.65	1.37×10^5	10.62	1.59×10^5	14.6
"	9.9×10^4	41.2	1.37×10^5	13.94	1.67×10^5	3.16
"			1.35×10^5	37.7		
"			1.34×10^5	42.82		
0.50	5.32×10^4	4.62	6.74×10^4	13.94	8.06×10^4	11.2
"	4.92×10^4	64.8	6.65×10^4	85.5		
0.418			5.52×10^4	106.6		
0.400					6.30×10^4	85
.300	3.07×10^4	17.65	4.10×10^4	42.82		
.202			2.67×10^4	106.6		
.200	2.08×10^4	64.8	2.71×10^4	37.7	3.24×10^4	11.2
			2.57×10^4	175.5	3.23×10^4	14.6
.171			2.26×10^4	85.4		
.100	1.025×10^4	64.8	1.35×10^4	42.82	1.58×10^4	11.2
			1.32×10^4	106.6		
.0945			1.21×10^4	175.5		
.089	9.70×10^3	57.6				
.052	5.60×10^3	41.2				
.05	5.20×10^3	64.8	6.85×10^3	37.7		
"			6.86×10^3	175.5		
.04					6.12×10^3	85.0

Table XIII - NH_3

(Contd)

E/p_{300} (volt/cm-mm Hg)	W_e (195°K) (cm/sec)	p_{300} (mm Hg)	W_e (300°K) (cm/sec)	p_{300} (mm Hg)	W_e (381°K) (cm/sec)	p_{300} (mm Hg)
.0343	3.65×10^3	51.6				
.0300			4.03×10^3	37.7		
			4.06×10^3	42.82		
.02	2.08×10^3	64.8			3.30×10^3	85.0
.01			1.37×10^3	120.9		

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13. ABSTRACT

This report presents in tabulated form the drift velocities of electrons in various gases. The drift velocities were measured in helium, neon, argon, krypton, xenon, hydrogen, deuterium, nitrogen, carbon monoxide, carbon dioxide, water vapor, nitrous oxide, and ammonia for E/p values from 10^{-4} to 30 volts/cm-mm Hg at several gas temperatures between 77°K and 443°K. In all gases except neon measurements were extended to low enough E/p such that the electrons were in thermal equilibrium with the gas.

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